PROTECTA
Electronics Co. Ltd

OGYD2-EP

Bus-bar differential protection and circuit breaker failure protection
based on optical fiber cable links

User's Guide

Budapest, 2004

Nr.:EO-13-13935-01

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1 Field of application

The bus-bars play an important role in the high voltage electric power system. Since the bus-bar concentrates the short-circuit power, destructive effects caused by a fault, by a device failure, by a handling mistake or by any other reasons are very high. A high-speed bus-bar protection with high reliability can decrease the damage.

The **OGYD2-EP** type three phase biased bus-bar differential protection and circuit breaker failure protection, based on optical fibre cable links developed by PROTECTA Electronics Co. Ltd. can be used for this aim. Information (currents, voltages, status indications, trips) from the bay units are sent to the central unit via high-speed series lines of optical fibre cable. The central unit performs bus-section-selective protection with independent measuring relays assigned to the actual bus-bar configuration. The central unit evaluates the information, and detects bus-bar faults and the failure of a breaker, and generates backup trip command if it is necessary.

2 Main characteristics

The devices of the ***OGYD2-EP*** bus-bar differential protection and circuit breaker failure protection system are members of the ***EuroProt*** device family made by PROTECTA Electronics Co. Ltd.

The main characteristics concerning the operation of the bus-bar protection system are as follows:

2.1 Functional characteristics

- one central unit,
- one bay unit for each bays,
- the bay unit can be an ***EuroProt*** type distance protection or an overcurrent protection, which is extended by a "bay module",
- all bay units are interconnected with the central unit via high-speed serial fiber optic cable pair,
- the bay units send to the central unit the following information:
  - the current values of each phases sampled synchronized with 1 ms time steps,
  - presence or absence of the three phase voltages,
  - the status of bus disconnectors of the bay using two bit status signals,
  - starting command for the bay breaker failure protection,
  - signal of the trip command for the circuit breaker in the individual phases;
- the central unit is of numerical type, operating with a main processor (CPU main) and separated digital signal processor (CPU OGYD),
- the central unit sends to the bay units the following information:
  - synchronizing signal with 1 ms time steps,
  - trip command, if needed;
- all currents and binary signals are of three-phase information,
- the central unit determines the bus-bar configuration based on the signals received via fiber optic cable, and assigns measuring elements to the independent bus sections,
- the measuring elements build the sum of the currents (current difference) and calculate the biasing current based on the current magnitudes,
- the decision of the measuring elements is based on the characteristics with a single knee point,
- because of the special decision logic the operation is safe even in case of high grade of CT saturation,
- to issue the trip command the voltage breakdown condition must be fulfilled as well,
- operating time is below 20 ms (see section 7 *Technical data* in detail).
- The breaker failure protection has two steps, the first step generates a new trip command to the own circuit breaker, the second step issues general trip command to all circuit breakers.

2.2 Software characteristics:

- integrated self-check functions,
- digital event recorder for 50 events, and an event sequence recorder with 1 ms time resolution for maximum 300 events,
- analogue event records with current data.

2.3 Hardware characteristics:

- numerical type, with own A/D converter, digital signal processor (DSP) and separate main processor,
- the system can be structured in two versions:
  - centralized structure, when the central unit and the bay units are mounted in a cabinet,
  - decentralized (bay oriented) structure, when the central unit is mounted in a central cabinet, the bay units are located near to the individual bays,
- opto-coupler inputs,
- output contacts,
- the type of the contacts (NC or NO) can be selected individually for each contacts when ordering,
- versions for 19" rack cabinet mounting or housed in relay case (semi-flush mounting or hinged type).
- optional DIGIPROT fault recorder board.

2.4 Communication:

- 2x16 character LCD display for setting the functions, displaying messages and reading recorded events,
- on-line screen on external PC to make setting, commissioning and testing easier,
- external communication interface, can be set for RS 232 or for fibre optic cable,
- optional interface module for SCADA systems,
- the parameters can be saved and downloaded,
- real time clock handling with the help of RAM with battery, (which can be synchronised via optical fibre cable connected to external PC or to the SCADA system).

3 Working principle

The OGYD2-EP numerical protection integrates two independent protection functions:

- numerical differential protection,
- breaker failure protection.

3.1 Numerical bus-bar differential protection

3.1.1 Method of operation

The numerical bus-bar differential protection system consists of a central unit and individually one bay unit for each bays.

The structure of the system can be centralized, where the central unit and the bay units are mounted in a cabinet, or it can be decentralized (bay-oriented), when the central unit is mounted in a central cabinet and the bay units are located near to the bays.

The bay unit can be an ***EuroProt*** type distance protection or overcurrent protection, which is extended by a driver unit for fiber optic link (OXO). In this configuration this bay module exploits the power supply unit, the integrated input units and the A/D converter of the ***EuroProt*** device. To receive the status signals of the by disconnectors, the free digital inputs of the device can be applied, or an additional optically isolated binary input module can be inserted in the distance protection or overcurrent protection.

If the bus configuration to be protected contains bus disconnectors as well, the status signals from these devices are to be connected to the central unit.

All bay units are interconnected with the central unit with a high-sped serial line in the form of a pair of fiber optic cable (send and receive). This fiber optic connection is applied in the central configuration as well.

The parameter settings of the protection system is stored in the central unit's CPU MAIN module, the parameter setting process and the communication with the system is controlled by this unit too. The further tasks of this unit are event recording, controlling the auxiliary modules, supervising the signals of the optically isolated input module of the central unit, operating the output relays and running the PROTLOG equation system.

After energizing the unit, and after each parameter modifications the CPU main sends the parameters of the configuration to the CPU OGYD located in the central unit as well. After receipt of these data, the bus-bar differential protection function is performed by the CPU OGYD module alone, the data exchange between the MAIN and OGYD is limited to the status signal connected to the central unit and to the signals indicating the operations.

The bay units send the status signals with two bits (on and off state) of the bay disconnectors in each milliseconds via high-speed fiber optic connection to the central unit. Additionally the bay unit sends the information about the presence or absence of the voltages in all three phases, the commands submitted to the bay circuit breakers and breaker failure information received by the bay unit from external sources or generated by the own breaker failure function.

Following the device energizing and after each parameter modifications, all disconnectors are supposed to be disconnected. If there are no changes in the status signals in the subsequent 10 ms then based on the received signals the OGYD2 performs "configuration", which means determination of the bus-bar lay-out in the substation, and assigns "measuring elements" to each separated bus sections. This process is performed after each changes in the status of all disconnectors, so after 10 ms the protection adapts itself to the new configuration, and the measuring element is reconfigured. In normal operation when receiving faulty status signals from the disconnectors the device keeps the previous state and generates error signals, but supposing the previous bus-bar configurations keeps on operating. If the status error is detected after energizing or following parameter changes, the protection remains disabled until the faulty status is corrected, and generates "Differential protection disabled" and "Breaker failure disabled" status signals as well.

The central unit sends synchronous signals to each bay units via fiber optic connection, and the bay units answer with sending sampled current values in each phases to the central unit. These values are used by the assigned measuring elements of the central unit. The measuring elements of the central unit perform the following tasks:

- summation of the sampled I_p momentary current values for the bays connected to the bus section:

$$I_{d.p} = \sum I_p$$

- then the current DC component is filtered by subtracting the actual value from that sampled 10 ms before, and the difference is divided by two

$$I_{d.p1} = \frac{I_{d.p} - I_{d.p-10ms}}{2}$$

- the same procedure is repeated with the subsequent sampled value and with the value sampled by 10 ms before that, and the procedure is repeated ten times. These ten calculated values are averaged, receiving the *Id* trip current:

$$Id = \frac{\sum_{n=1}^{10} I_{d.pn}}{10}$$

- additionally to the procedure above from the absolute value of the sampled I_p momentary current values a predetermined (with parameter setting) "a" load vale is subtracted $\left(\left|I_p\right| - a\right)$ (here *a*=**IOffset** parameter setting, the proposed value of it is the expected maximum load current value of each bay currents). Out of these differences the values above 0 (if $\left(\left|I_p\right| - a\right) > 0$) are summed

$$I_{s.p} = \sum \left(\left| I_p \right| - a \right)$$

- then the average of this value and that received 10 ms before is calculated:

$$I_{s.p1} = \frac{I_{s.p} + I_{s.p-10ms}}{2}$$

- the same procedure is repeated with the subsequent sampled value and with the value sampled by 10 ms before that, and the procedure is repeated ten times. These ten calculated values are averaged, receiving the *Is* biasing current:

$$Is = \frac{\sum_{n=1}^{10} I_{s.pn}}{10}$$

The biasing is calculated by multiplying the *Is* biasing current by a "K" biasing factor (parameter "*Biasing*" which can be set in the range 50% … 80% = 0.5 … 0.8):

$$K * Is = K * \frac{\sum_{n=1}^{10} I_{s.pn}}{10}$$

The bus-bar differential protection operates if:

$$Id \geq K * Is$$

and

$$Id \geq Id_base$$

The measuring element assigned to the bus-bar section shifts the ten-point window of the procedures by 1 ms, and the procedure is repeated 8 times. If all steps result trip condition, which means that the trip condition lasts for 8 ms, the measuring element generates trip command for the bus-bar section.

The subtracted *a*=**IOffset** value is parameter setting, the proposed value of it is the expected maximum load current value of each bay currents, and will be common for all bays. The consequence of this setting is that independently of the number of the bays and independently of the actual load, in normal operation the biasing *K*Is* value is constant zero. This is because the summation contains elements only for which $\left(\left| I_p \right| - a \right) > 0$. In case of internal bus-bar faults the maximal trip speed is realized, the optimal trip time can be 8 ms.

The trip characteristic for a measuring element is shown in Fig. 1.

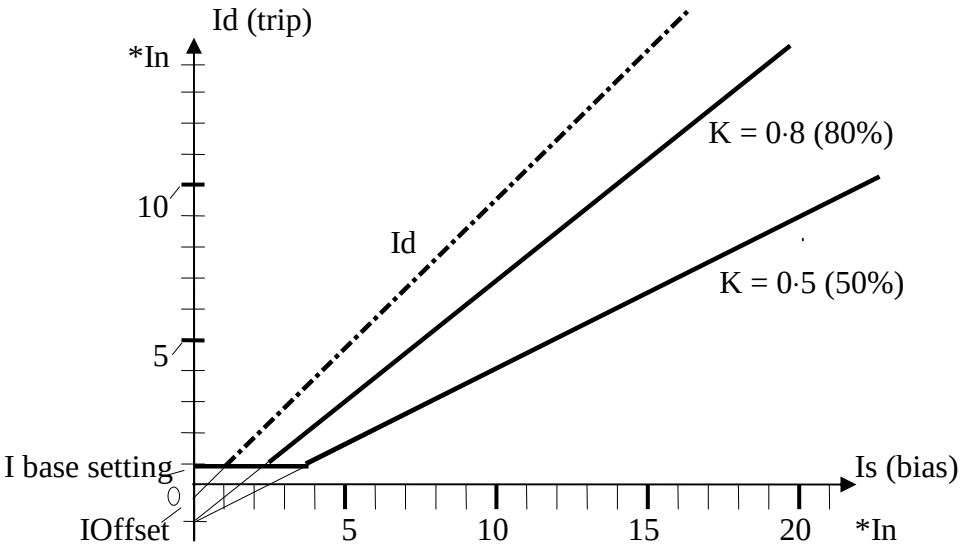


Fig.1 The trip characteristic for a measuring element

For an internal bus-bar fault the measuring principle described above can be seen in Fig.2.

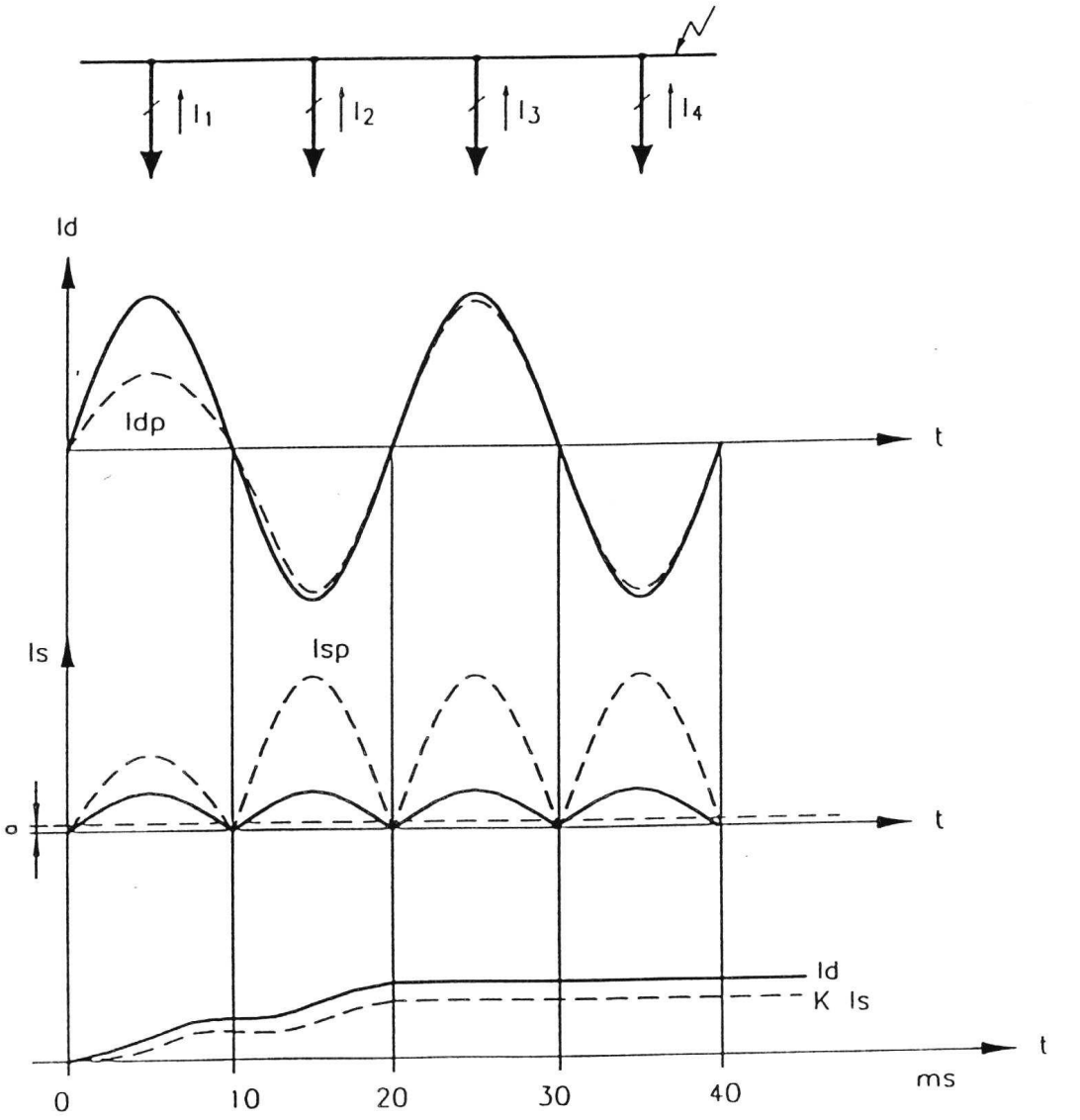


Fig.2 Measurement of internal bus-bar fault

The top of Fig.2 shows a simple bus-bar section configuration. Supplying the internal fault, all currents flow in the same direction. The "Idp" time function in the second row of Fig.2, drawn dashed, in the first half period has half value, because of the average calculation $I_{d.p1} = \frac{I_{d.p} - I_{d.p-10ms}}{2}$ is based on the sampled value summation $I_{d.p} = \sum I_p$ and that sampled 10 ms before.

The "Isp" time function in the third row of Fig.2, drawn dashed, in the first half period has half value too, because of the average calculation $I_{s.p1} = \frac{I_{s.p} + I_{s.p-10ms}}{2}$, based on the calculation mentioned before: $I_{s.p} = \sum\left(\left|I_p\right| - a\right)$, if $\left(\left|I_p\right| - a\right) > 0$), and because in normal operation these values are continuously zero, as the "a" load current value is continuously subtracted.

The bottom curve in Fig.2 shows Id and K*Is, which is the result of averaging 10 values:

$Id = \frac{\sum_{n=1}^{10} I_{d.pn}}{10}$ and $K * Is = K * \frac{\sum_{n=1}^{10} I_{s.pn}}{10}$.

As before fault both *Id* and *K*Is* are zero the bottom curves in Fig. 2 increase step-by-step. In the evaluation there is no intentional time delay or measured value exclusion. Tripping is generated after 8 consecutive starting of the function. In case of internal fault as Fig.2 shows, *Id* is continuously above *K*Is*, and after 8 comparisons the measuring element automatically generates trip command. The command detected on the output relay is somewhat delayed because of the operating time of the relay. The duration of the trip impulse is at least 500 ms, the algorithm resets the command only after this time delay, if the conditions are reset meantime. The drop-off ratio of the trip current is 1.

The bus-bar differential protection function can be disabled by an output variable (*BB prot. disable*) of the PROTLOG equations. Using the parameter "*BB diff. prot.disable"* the function can be fix disabled. In this case the assigned LED is signaling the disabled state, and the PROTLOG equation has no influence.

The measuring principle in case of external fault is shown in Fig. 3.

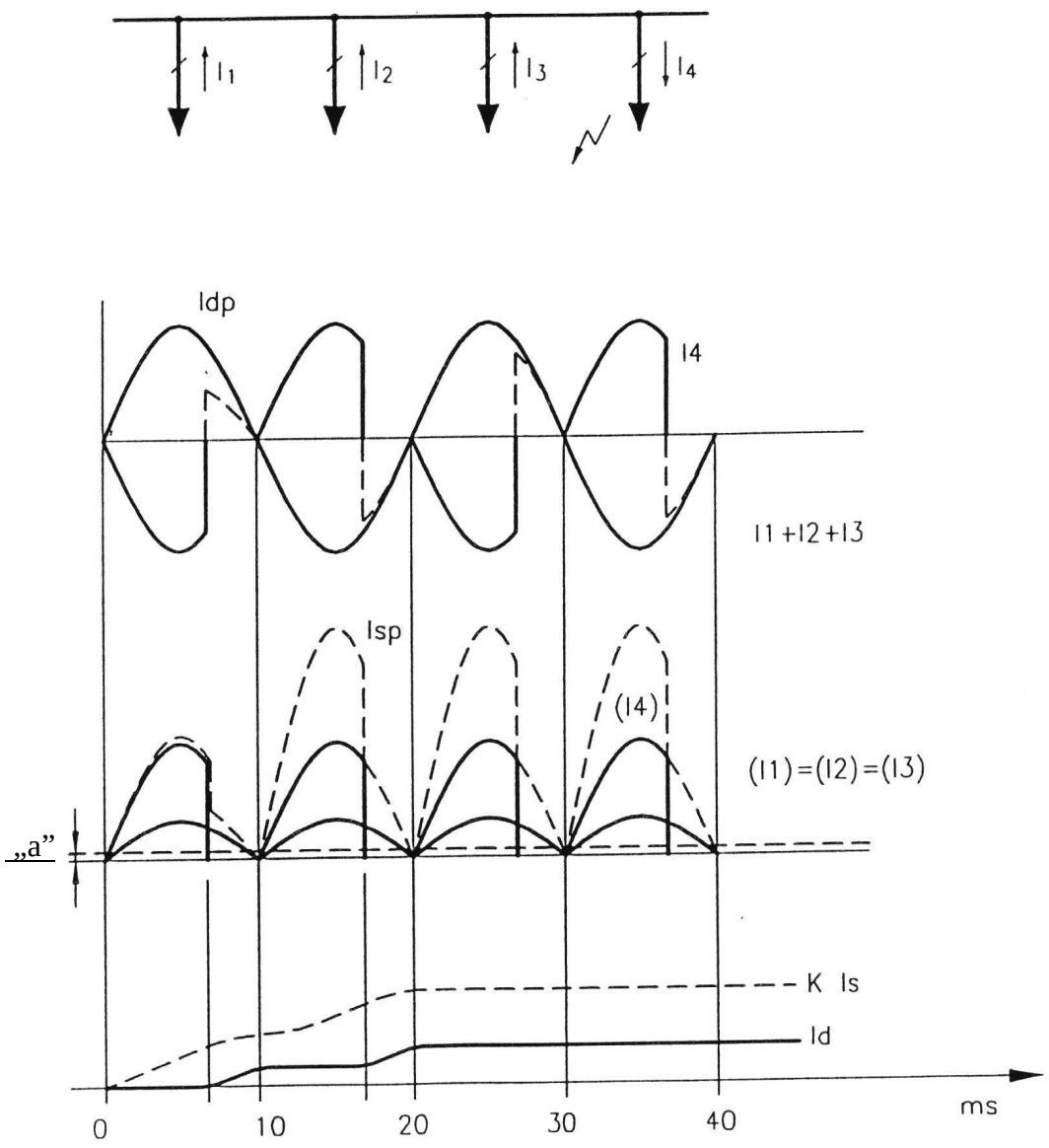


Fig.3 Measurement of external fault

The top of Fig.3 shows a simple bus-bar section configuration, where Bay 4. has an external fault. The currents in the healthy bays flow in the same direction, the fault current in Bay 4 is the sum of these currents, and flows in inverse direction. Because of concentrated fault current the CT in Bay 4 can be saturated. The second row of Fig.3 shows that opposite to the sum of the healthy bay current (I1+I2+I3) the I4 bay current is not exactly the inverse, some current samples are "missing" as caused by the distortion of the saturation. (The Fig.3 shows

"ideal" saturation!). In calculation of *Idp*, this "missing" current section is detected (dashed line)

The third section of Fig. 3 shows the calculated Isp (dashed line too). It is clearly seen that the biasing current increases immediately, and because of the saturation the increasing is slowed down only at the end of the first half period. Of course in the first half period the values are halved, as in case of internal fault.

As the fourth section of Fig. 3 shows the summed *K*Is* biasing current is continuously above *Id*. So in case of K=0.8 the comparison performed in each millisecond never cause operation of the differential protection function.

Based on Fig.3 the limits of the measuring principle of OGYD2 can be explained:

- Let's suppose that the current transformer of the faulty bay saturates at I_T current, and that the current transformer can not deliver secondary current in saturated state ("ideal saturation").
  If the sum of the currents on healthy bays is *Izm* (this is the maximal fault current, when the protection operates correctly), in the faulty bay it is only I_T (less than the fault current) then the trip current is:
  $$Id = Izm - I_T .$$
  The biasing current is with similar procedure:
  $$K * Is = K * \left[(Izm + I_T) - n * a \right]$$
  where *n* is the number of the bays,
  a is the subtracted load current value.
  In the following explanation *a=0* setting value is supposed.

  The trip equation is:
  $$Id \geq K * Is$$
  which yields with substitution of the expressions above:
  $$Izm = I_T \frac{1+K}{1-K}$$
  This equation helps when setting the *K* biasing factor supposing the maximal *Izm* or determination of the maximal *Izm* in case of a given *K* setting.

  Example: if the current transformer with rated current of 250 A primary saturates at I_T=2500 A, and the setting is *K=0.5*, then *Izm= 3*IT=30*In=7500 A*, if the setting is *K=0.8*, then *Izm= 9*IT=90*In=22500 A.*

  These data show, that for stationary state this protection provides a sufficient protection.

- If a current transformer is at the saturation limit in stationary state, (the fault current is equal with the saturation value) then the flux reaches the saturation level, and the "time to saturation" of the current transformer is 10 ms, and the current peak value is I_{Tcs}=1.42*I_T. If the current exceeds this value, then the current transformer saturates in

shorter time than 10 ms. based on the principle of equalty of areas the "time to saturation" can be calculated as shown below (supposing "ideal" saturation):

$$t_T = \frac{1}{\omega}\arccos\left(1-\frac{2}{\frac{Izm}{I_T}}\right)$$

The maximal current, at which the current transmission of the current transformer is distortion-less, which means that the current value at the moment of t_T, related to the $I_{Tcs} = \sqrt{2}I_T$ is:

$$\frac{I_{cs}}{I_{Tcs}} = \frac{Izm}{I_T}\sin\omega t_T$$

The relations of these last two equations are shown in Fig. 4.a.

In case of a bus-bar with high short-circuit power the current transformer in the faulty bay can be extremely saturated. Fig, 4.b shows two cases supposing "ideal" saturation. In one case the time to saturation is 2 ms, in the other one it is 3 ms.

Based on the equations above the data are:

for $\frac{Izm}{I_T} = 5$ $\quad$ t_T=3 ms and $\frac{I_{cs}}{I_{Tcs}} = 4$

for $\frac{Izm}{I_T} = 10$ $\quad$ t_T=2 ms and $\frac{I_{cs}}{I_{Tcs}} = 6$

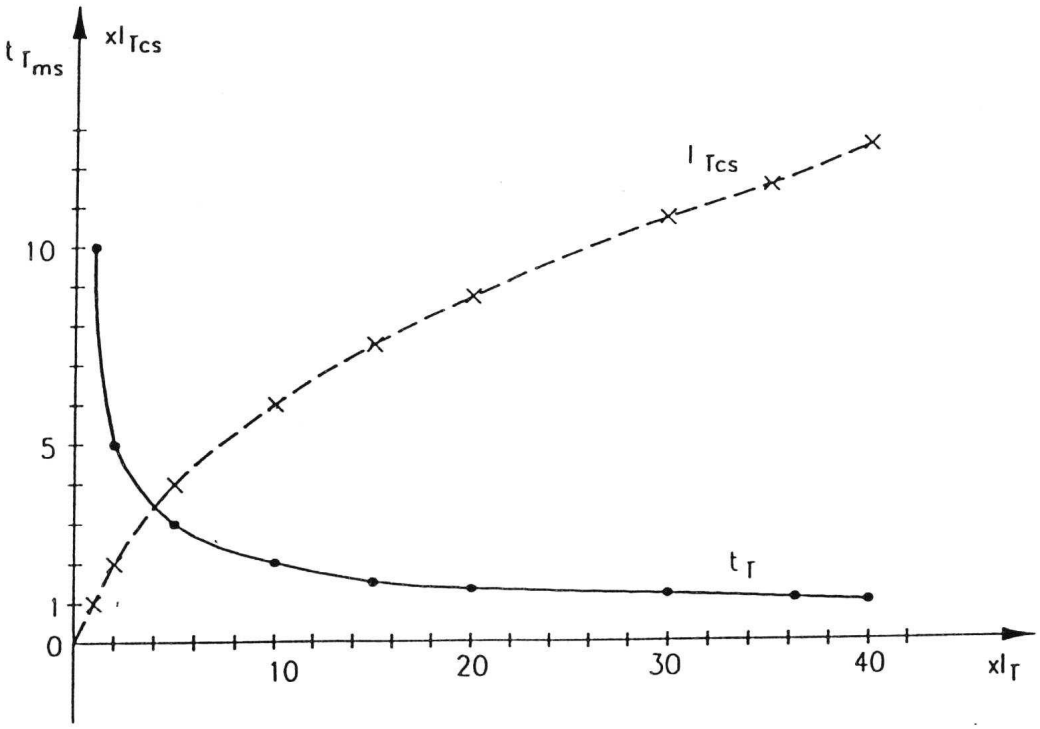


Fig. 4.a Time to saturation and the maximal transmitted current as the function of the fault curent

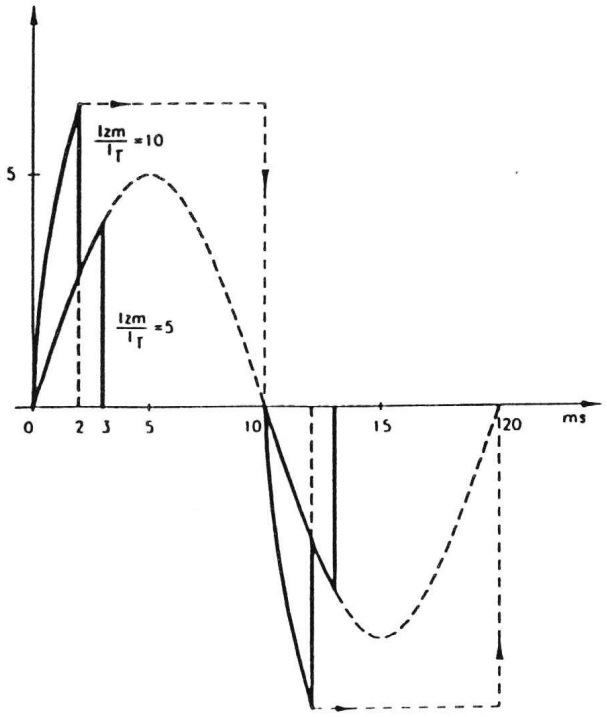


Fig. 4.b External fault causing extreme saturation (supposing „ideal saturation")

In case of external fault, even if the time to saturation is below 2 ms, there can be a considerable time span, when Id>K*Is see Fig. 5. If this time is more than 8 ms, then the measuring element generates a false trip command for external fault. This can occur in case of high grade of transient saturation.

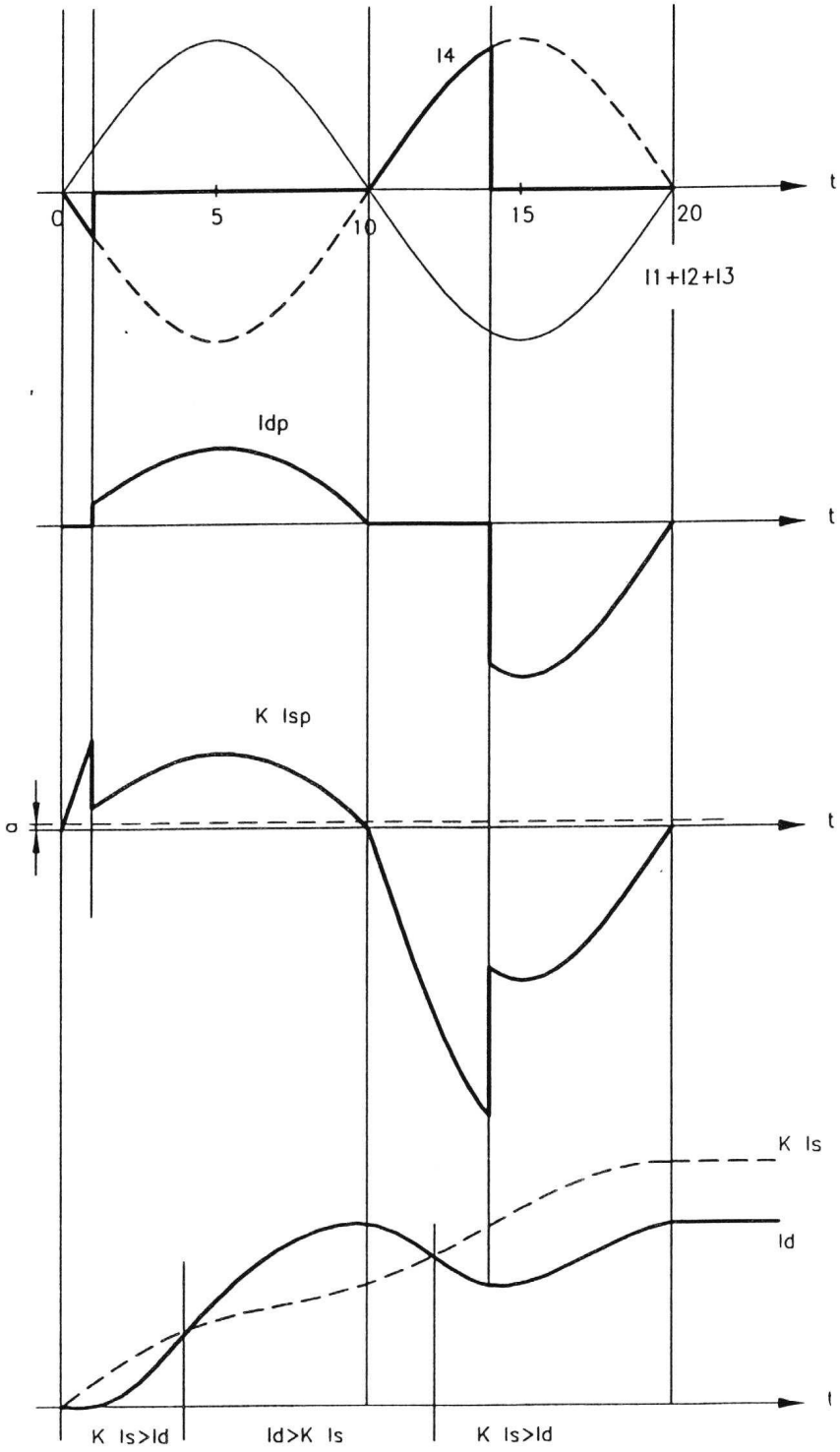


Fig. 5 External fault with 1 ms time to saturation

To avoid false trip command in case of external fault the ***OGYD2-EP*** device uses the following method. As it can be seen in Fig. 5, at the beginning the biasing current is always above the trip current, and in this time the measuring element blocks the trip command. This blocking can never occur in case of internal fault, so in case of initial blocking it can be always supposed that the fault is an external fault. So if the biasing current is above the tripping current even in one step, then the measuring element switches over from 8 to 25 for the count limit of tripping conditions (the duration is in this case 25 ms). This method assures correct operation in case of extreme saturation as well.

The application of the method above does not result increasing operating time in case of internal fault, because the 25 times checking can occur only for external faults. The only exception is the "transition" of the fault location, when a close external fault evolves to internal fault. In this special case the operation can be expected only after a 25 ms time delay, but this method increases stability for external faults.

To avoid false tripping OGYD2-EP applies another safety method too. All bay units of the bus-bar differential protection system monitor in all three phases the increasing and decreasing periods of the bay currents. If in a bay the current increases, subsequently decreases within 3 ms, then the protection algorithm keeps the last high value up to the end of the half period. This method supplies at least partly the missing current samples, and at the same time no excess in biasing current can occur, because this curve shape results the same current value as the unsaturated one if the time span is 2 ms, and about the half value if the time span is 1 ms. (See Fig. 4 b.).

This method results suitable biasing and a small *Id* value, which assures stability for stationary external faults even in case of 40 times saturation current (e.g. for n=10 this means 10*40=400 times rated current).

This explanation proves the use of the method keeping the last high value up to the end of the half period.

It has to be mentioned that even in extreme cases the method of changing the number of checking from 8 to 25 can prevent false tripping with high reliability. As the result of the application of the methods explained above the operation of the protection is reliable in case of extreme stationary saturation and for high residual flux value as well. The only requirement of the protection is $t_T \geq 1$ ms minimal time to saturation (the time span, when the current transition is distortion-less).

The bus-bar differential protection measures in all three phases, but the trip command is generated common for all three phases of the circuit breaker.

3.1.2 Voltage breakdown condition

The trip command is released only if in the affected bay and in the affected phase the voltage collapses.

To perform this supervision all bay units monitor the presence of the voltage with a quick voltage measuring function. The result of the supervision is sent to the CPU OGYD in every milliseconds. If the voltage is below 0.7Un, the function drops. If any of the voltage functions signals low voltage then the operation of the assigned measuring element is enabled, and if the currents fulfill the differential criteria the algorithm generates a trip command.

If the differential protection function started and the bay units received trip command then this voltage condition does not play any role. The trip command resets only if the currents are outside the tripping zone of the characteristics.

A voltage monitoring function can allow trip command only for 5 s, then the function is disabled until the measured voltage returns to healthy state again, or a new initializing is performed (caused by disconnector status change, switching on, parameter changes).

If all voltage monitoring functions assigned to a measuring element detect low voltage then the bus-bar section is considered to be disconnected, and the operation of the bus-bar differential protection is enabled again (to cover the switch-on-to-fault condition).

If the trip command is disabled by the voltage condition then the "On-line" screen of the connected PC displays the status signal as "U>disable: +". If one or more voltage supervisions detect low voltage then the display changes form "+" to "-". At that moment a 5 s timer is started, and when it expires then the operated voltage supervision function is disabled. As a consequence the signal shows "+" again.

3.1.3 Supervising the current transformer circuits

Each measuring element supervises he current transformers the bay of which is connected to the bus-bar section.

The central unit measures with each measuring element in all three phases the current differences. If the differential current value in any phases is above the current error setting *Iset*(*CT error*), but the associated voltage is healthy (*U>block:*-), then a timer is started (*CT error delay*). If this timer expires CT error signal is generated and the trip command is blocked. The condition to start the timer is:

[U>block: –]*{(Idr>Iset[CT error])+(Ids>Iset[CT error])+(Idt>Iset[CT error])}

The CT error state is considered to reset if the differential current is below the current error setting in all three phases:

(Idr<Iset[CT error])*(Ids<Iset[CT error])*(Idt<Iset[CT error])

If the conditions are fulfilled then after a drop-off delay the status is reset, and the protection is operable again. The drop of delay timer and the start delay timer operate with the same parameter setting (*CT error delay*).

During normal operation of the power system there is no possibility to set the CT error state. If however the protection is tested in the laboratory, or current is injected into the device, care must be taken, because the CT error state after the time delay disables trip command.

3.1.4 Fiber optic cable supervision

Additionally to the data communication the COM3 modules inserted in the central unit have the important task to supervise the healthy state of the fiber optic cable lines. A precise integrating algorithm is applied to recognize the line error within 3 ms. The signal of the error state is transmitted to the CPU OGYD module. This line error signal disables trip command.

3.2 Digital breaker failure protection

3.2.1 Method of operation

The operation of the digital breaker failure protection integrated in the OGYD2-EP device is as follows:

A breaker failure protection function is assigned to each measuring element. In the supervision only those bays are included which are connected to the bus-bar section.

All bay units collect breaker failure start commands from the bay-oriented protection functions, and checks if current is flowing in the bay, and supervises if really trip command is sent to any of the circuit breaker trip coils of the bay. If all conditions are fulfilled then without any time delay the bay unit sends a message to the central unit with the content that the possible state is breaker failure.

The starting conditions for breaker failure protection starting are as follows:

a) In a transformer bay (no current supervision is involved):

BFstart*(RTripI.+RTripII.+STripI.+STripII.+TKiI.+TTripII.)

b) In a bay without transformer (the current is checked as well):

BFstart*[(RTripI.+RTripII.)*Ir+(STripI.+STripII.)*Is+(TKiI.+TTripII.)*It]

In these conditions:

BFstart the bay unit detected breaker failure start external signal in the dedicated optically isolated digital inputs

RTripI., RTripII, … the bay unit detected trip command as sent to the indicated phase and indicated trip coil in the dedicated optically isolated digital inputs

Ir, Is, It **t**he OXO modules in the bay unit measured the current in the indicated phase and generated permission, because the measured current value is above 0.1*In(bay).

The central unit receives the messages as generated in the bay units according to the conditions above, and starts the t1 and t2 timers. The time delays are set by parameters (*BF timer 1, BF timer2*). In case of timeout of t1 a command is sent to the selected bay unit to generate a new trip command to both trip coils of the circuit breaker (the duration of the command is 500 ms). If this command has no effect, and the conditions are permanently fulfilled, then after t2 time delay all circuit breakers connected to the bus-bar section receive the trip command (the duration of the command is 500 ms here too).

The breaker failure protection supervises the individual phases but generates a three-phase trip command.
The breaker failure protection function can be disabled using an output of the PROTLOG equation (*BF prot disable*). The parameter (*BF protection disable*) disables the function permanently. In this case the LED *BF disabled* indicates the disabled state, and the PROTLOG equation has no further effect.

3.3 Test mode

For the time of commissioning or checks the protection can be set to test mode. In this case no trip commands are generated. The parameter to be set is "Test". The parameter value is to be changed to "+" to set the device in test mode.

4 Information from and to OGYD2-EP bus-bar differential and breaker failure protection

4.1 Parameter setting and setting ranges

Setting of the differential characteristics (primary current values):

NAME	DIM.	RANGE/STEP	Explanation
I base setting	[A]	(50-5000/10)	Differential characteristics current base setting
Biasing	[%]	50-80/5	Slope of the characteristic
I Offset	[A]	(0-5000/10)	Expected maximal bay load current ("a")
Iset(CT error)	[A]	(10-5000/25)	CT current error setting

Bay setting data as stored in the central unit (primary CT rated current values):

NAME	DIM.	RANGE/STEP	FIX DISCONNECTED
In[1st bay name]	[CT Pr. A]	(50-5000/25)	+/-
In[2nd bay name]	[CT Pr. A]	(50-5000/25)	+/-
…			
In[nth bay name]	[CT Pr. A]	(50-5000/25)	+/-

The bay is considered to be permanently disconnected, if the setting is "+".

Timer parameters

NAME	DIM.	RANGE/STEP	Explanation
CT error delay	[ms]	(100-32000/10)	Timer setting for CT error signaling
BF timer 1	[ms]	(0-32000/10)	Breaker failure timer 1
BF timer 2	[ms]	(0-32000/10)	Breaker failure timer 2
Disc. status error timer	[s]	(1-60/1)	Disconnector status error time delay

Voltage condition parameter:

NAME	Value	Explanation
Bay voltage condition	0.7 Un	Fix setting

Logic parameters:

NAME	Explanation
Bay fix disconnected	Bay fix disconnected
Bus-bar diff.prot disable	Bus-bar differential protection disable
BF protection disable	Breaker failure protection disable

Communication parameters

NAME	Explanation
Opto/RS (0/1)	Selection of serial port: fiber optic connector or RS232
FiberOpticLoop 1=Yes	1=operation in loop, 0= radial connection
BaudRate:	Setting range: 150 … 19200 Baud, step *2
Device Code:	Device identifier, setting range 0 … 254
Station Code:	Station identifier, setting range 0 … 254

4.2 List of evaluated events

NAME	Explanation
Protection start:	'yy . mm . dd hh : mm : ss : ms
Protection reset:	'yy . mm . dd hh : mm : ss : ms
BB diff prot. operation	Bus-bar differential protection operated
BF prot. operation	Breaker failure protection operated
Trip bay 1	Trip command to bay 1
Trip bay 2	Trip command to bay 2
…	
Trip bay n	Trip command to bay n

4.3 List of digital events

NAME	Explanation
Test state	Commissioning state
BB diff prot. disabled	Disabled state of the bus-bar differential protection function
BF prot. disabled	Disabled state of the breaker failure protection function
OX error	OXO fiber optic driver or fiber optic connection error
Disconn. error	Disconnector status signal discrepancy
Bay 1 trip	Bay 1 is disconnected by the protection
Bay 2 trip	Bay 2 is disconnected by the protection
..	
Bay n trip	Bay n is disconnected by the protection
For each measuring element:	
M1 trip R	Trip command of the measuring element 1 in phase R
M1 trip S	Trip command of the measuring element 1 in phase S
M1 trip T	Trip command of the measuring element 1 in phase T
M1 BF prot. start	Measuring element 1: breaker failure protection start
M1 BF prot. trip	Measuring element 1: breaker failure protection trip command
M1 CT circuit error	Measuring element 1: current transformer circuit error
M1 VT OK	Measuring element 1: voltage transformer OK (or permanently neglected)

4.4 List of LCD messages

MESSAGE	Explanation
DSP error	Digital signal processor error
BB diff. prot. trip	Bus-bar differential protection generated trip command
BF prot. trip	Breaker failure protection generated trip command
CT circuit error	Current transformer circuit error

4.5 On-line information

The On-line screen is displayed on a connected PC, running *Protect for Windows* operating software under Windows environment. (See *EuroProt complex protection hardware and software description and user's manual*). The measured current values are displayed in primary Ampers. The bay currents are approximate values based on rectified average measurement.

Information for each measuring elements:

Measuring element 1

Delta:		Summa:	
Idr	0 A	Isr	0 A
Ids	0 A	Iss	0 A
Idt	0 A	Ist	0 A
Trip R	-		
Trip S	-		
Trip T	-		
BF start	-		
BF trip	-		
CT error	-		
U>block	-		

Bay information:

[1st bay name	] current	123	Trip	-
[2nd bay name	] current	123	Trip	-
…				
[nth bay name	] current	123	Trip	-

Common information:

Test state:	-
BB prot disabled	-
BF prot disabled	-
Opto error	-
Disconn. error	-

Service information:

O(1..8)=00 O(9..16)=00	O(17..24)=00 O(25..32)=00
Internal variables (1..16):	0000
Timer start:	0000
Timer timeout:	0000
10 ms timer start:	00
10 ms timer timeout:	00

Timers for each measuring element:

CT error timer start	0
CT error timer drop-off	0
VT timer	0
BF timer	0

4.6 Inputs and outputs of the PROTLOG equations

Inputs (source variables):

INPUT VARIABLE	Explanation
O5 …O8	State of optically isolated inputs 5 … 8
BB operated	Bus-bar protection operated
BF operated	Breaker failure protection operated
CT error	Current transformer circuit error
M1 … Mm trip	Measuring element 1 … m trip command
Disc. status error timeout	Disconector status error timeout
OX error	OXO fiber optic connection error
Disc. status error	Disconnector status error
SW1 ackn.	Acknowledgement with SW1 push-button

All input variables are repeated with "*", where "*" means latched signal.

Outputs:

OUTPUT VARIABLE	Explanation
R13 … R16	Operation of output relay 13 … 16
BB prot. disable	Bus-bar protection disable
BF prot. disable	Breaker failure protection disable
Ackn.	Acknowledgement

4.7 LED assignment and SW buttons

LED	Explanation
1.) LCD	Warning LED: indicates message on the display, parameter changes or need of acknowledgement
2.) ΔI>	Differential protection function operated
3.) Disconn.	Disconnector status signal error
4.) Line error	Fiber optic connection error
5.) BF disable.	Breaker failure protection disabled by parameter setting
6.) BB disable.	Bus-bar diff. protection disabled by parameter setting
7.) Test	Test state as set by parameter

SW switches	Explanation
SW2 (upper)	No assignment in this configuration
SW1 (lower)	Acknowledgement (valid for the bay units too)

5 Construction, external connections

The construction and external connections of the ***OGYD2-EP*** bus-bar differential protection and breaker failure protection are explained in Figures 6…15. Figures 6 … 11 show the connections of the bay unit, Fig. 12 … 15 show those of the central unit.

5.1 Drawings for a DTVA-OGYD2-EP device

Fig. 6 shows the external connections of a combined ***DTVA-OGYD2-EP*** device (distance protection and automatic recloser combined with the bay unit of the bus-bar protection), important from the ***OGYD2-EP*** functionality. Some connections are common with the functions of the ***DTVA*** functions (e.g. current and voltage inputs, power supply, trip command, etc.), others serve the bus-bar functions only (e.g. disconnector status signals, fiber optic inputs for the trip commands). This Figure does not show the two fiber optic connectors for the laser-driver OXO module.

Fig. 7 is the complete list of connections of a ***DTVA-OGYD2-EP*** device (distance protection and automatic recloser combined with the bay unit of the bus-bar protection).

Fig. 8 is the rear view of a ***DTVA-OGYD2-EP*** device, indicating the module identifiers, positions and connectors.

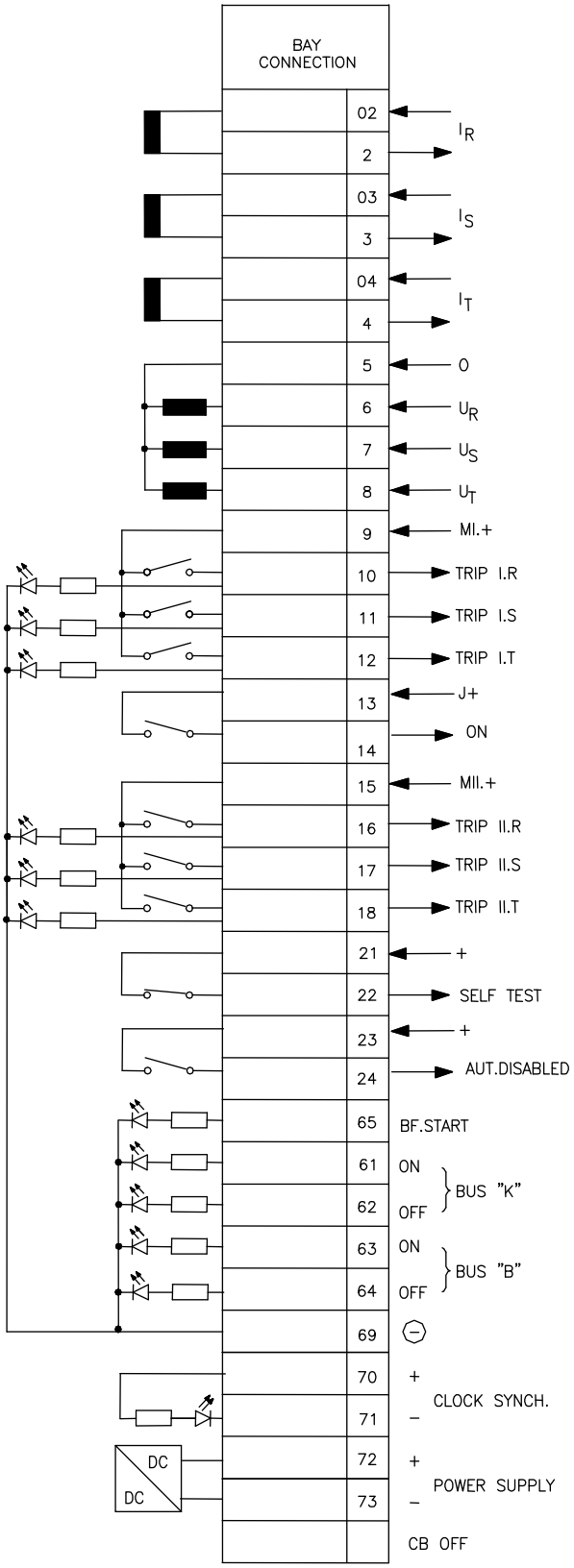


Fig. 6 Connections serving the OGYD2-EP functions of a bay unit of DTVA-OGYD2-EP type

"U" "V" CT2*		
Nr.	Denomination	ET
6	I_R	02
5	I_R	2
4	I_S	03
3	I_S	3
2	I_T	04
1	I_T	4

"S" "T" VT2		
Nr.	Denomination	ET
6	U_0	5↔
5	U_R	6
4	U_0	5↔
3	U_S	7
2	U_0	5↔
1	U_T	8

"K" U		
Nr.	Denomination	ET
1	M+	9↔
2	TRIP I.R	10↔
3	M+	9↔
4	TRIP I.S	11↔
5	M I.+	9↔
6	TRIP I.T T	12↔
7	J+	13↔
8	CB OFF	74
9	TRIP II.R	16↔
10	TRIP II.S	17↔
11	TRIP II.T	18↔
12		
13	OPTO-	69↔

"J" R4EI		
Nr.	Denomination	ET
1	M I.+	9↔
2		
3	TRIP I.R.	10↔
4	M I.+	9↔
5		
6	TRIP I S.	11↔
7	M I.+	9↔
8		
9	TRIP I.T	12↔
10	J+	13↔
11		
12	ON	14

"I" R4I		
Nr.	Denomination	ET
1	M II.+	15↔
2		
3	TRIP II.R	16↔
4	M II.+	15↔
5		
6	TRIP II.S	17↔
7	M II.+	15↔
8		
9	TRIP II.T	18↔
10	+	19
11		
12	K8	20

"H" R4E		
Nr.	Denomination	ET
1	SELF TEST +	21
2	SELF TEST -	22
3		
4	+	23
5		
6	K10(AUT.DISABL.)	24
7	+	25
8		
9	K11	26
10	+	27
11		
12	K12	28

"G" R4		
Nr.	Denomination	ET
1	+	29
2		
3	K13.	30
4	+	31
5		
6	K14	32
7	+	33
8		
9	K15	34
10	+	35
11		
12	K16	36

"F" R4E		
Nr..	Denomination	ET
1	+	37
2		
3	K17	38
4	+	39
5		
6	K18	40
7	+	41
8		
9	K19	42
10	+	43
11	K20	44
12		

"E" O		
Nr.	Denomination	ET
1	Synch.trip.enabl. +	45
2	Comm.error +	46
3	Remote enabl. +	47
4	Remote disabl. +	48
5	Aut. block.+	49
6	NHSC +	50
7	Manual ON +	51
8	Remote trip.	52
9	OPTO-(1-8)	69↔

"D" O		
Nr.	Denomination	ET
1	AR start	53
2	R ON status	54
3	S ON status	55
4	T ON status	56
5	AR disable	57
6	ON disable	58
7	Input 15	59
8	Input 16	60
9	OPTO-(1-8)	69↔

"C" O		
Nr.	Denomination	ET
1	Bus „B" OFF	64
2	Bus „B" ON	63
3	Bus „K" OFF	62
4	Bus „K" ON	61
5	BF start	65
6	TRIP I.R	10↔
7	TRIP I.S	11↔
8	TRIP I.T	12↔
9	OPTO-(1-8)	69↔

"A" "B" T4		
Nr.	Denomination	ET
1	Power supply +	72
2	Power supply -	73
3	Time synch.+	
4	Time synch -	

*Fig. 7 Complete list of connections of a **DTVA-OGYD2-EP** device*

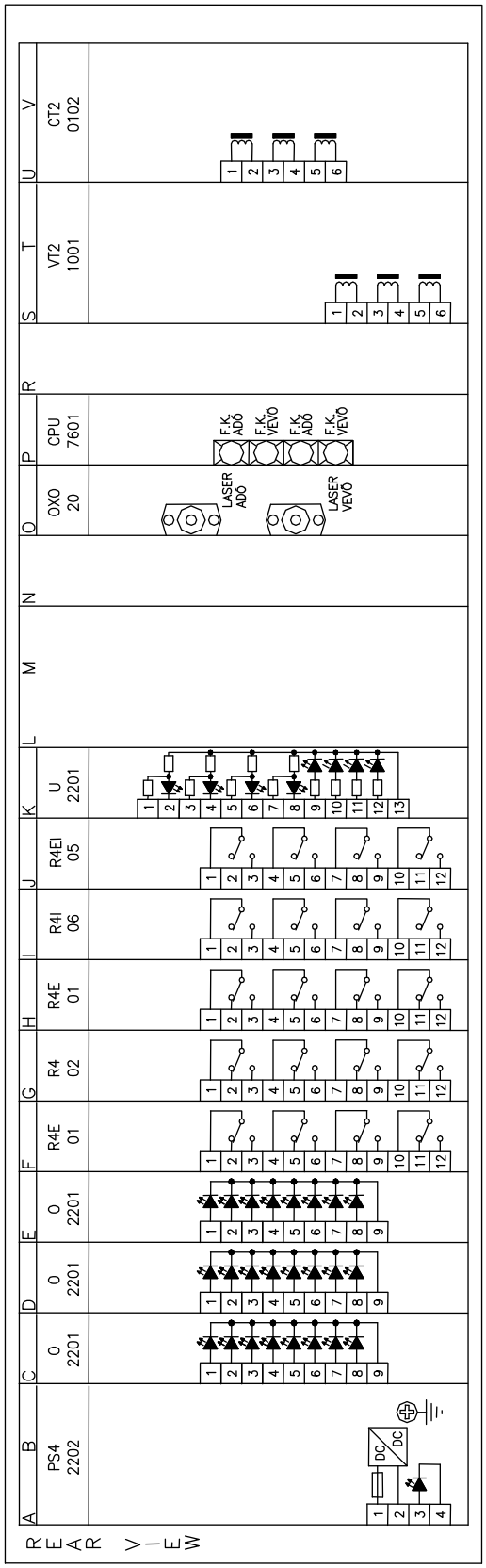


*Fig. 8 Rear view of a **DTVA-OGYD2-EP** device*

5.2 Drawings for a DTI-OGYD2-EP device

Fig. 9 shows the external connections of a combined ***DTI-OGYD2-EP*** device (overcurrent protection combined with the bay unit of the bus-bar protection), important from the ***OGYD2-EP*** functionality. Some connections are common with the functions of the ***DTI*** functions (e.g. current and voltage inputs, power supply, trip command, etc.), others serve the bus-bar functions only (e.g. disconnector status signals, fiber optic inputs for the trip commands). This Figure does not show the two fiber optic connectors for the laser-driver OXO module.

Fig. 10 is the complete list of connections of a ***DTI-OGYD2-EP*** device (overcurrent protection combined with the bay unit of the bus-bar protection).

Fig. 11 is the rear view of a ***DTI-OGYD2-EP*** device, indicating the module identifiers, positions and connectors.

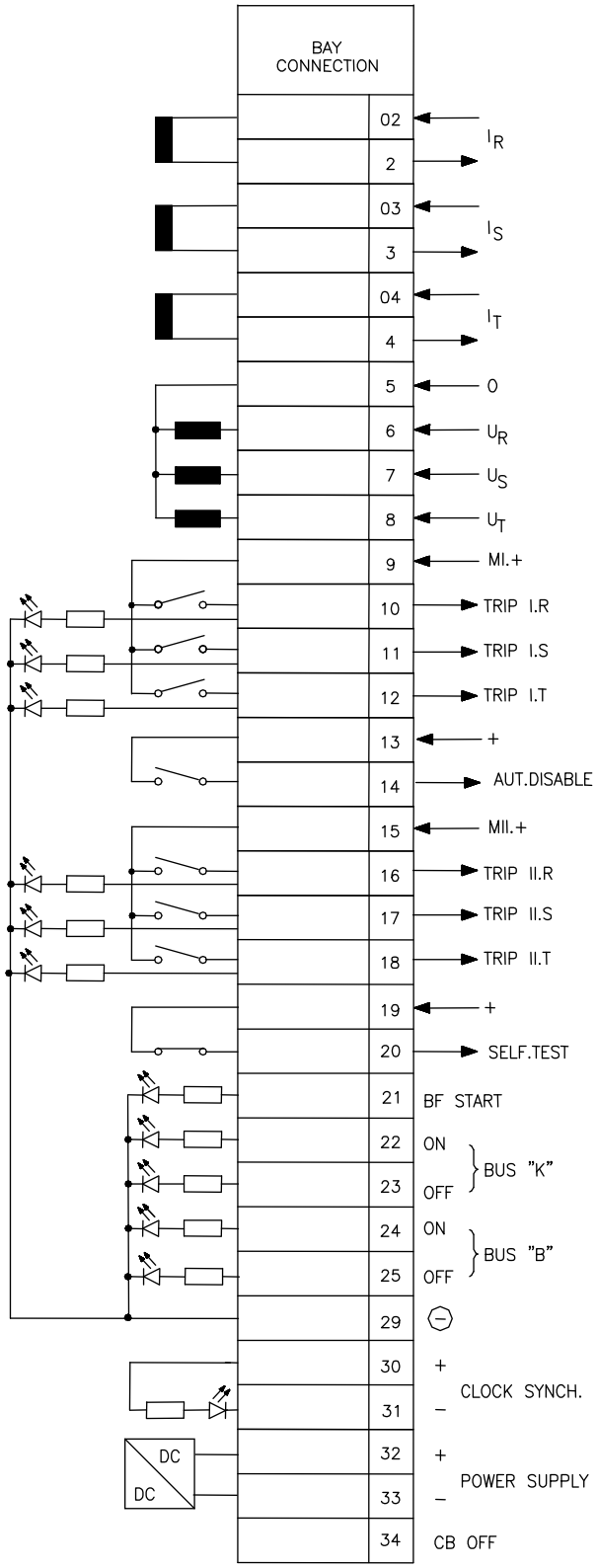


Fig. 9 Connections serving the OGYD2-EP functions of a bay unit of DTI-OGYD2-EP type

"U" "V" CT2*		
Nr.	Denomination	ET
6	I_R	02
5	I_R	2
4	I_S	03
3	I_S	3
2	I_T	04
1	I_T	4

"S" "T" VT2		
Nr.	Denomination	ET
6	U_0	5↔
5	U_R	6
4	U_0	5↔
3	U_S	7
2	U_0	5↔
1	U_T	8

"K" U		
Nr.	Denomination	ET
1	M I.+	9↔
2	TRIP I.R.	10↔
3	M I.+	9↔
4	TRIP I.S	11↔
5	M I.+	9↔
6	TRIP I.T	12↔
7	J+	13↔
8	CB OFF	34
9	TRIP II.R	16↔
10	TRIP II.S	17↔
11	TRIP II.T	18↔
12	INPUT	
13	OPTO-	29↔

"J" R4EÍ		
Nr.	Denomination	ET
1	M I.+	9↔
2		
3	TRIP I.R.	10↔
4	M I.+	9↔
5		
6	TRIP I.S.	11↔
7	M I.+	9↔
8		
9	TRIP I.T	12↔
10	K4+ (J+)	13
11		
12	K4 (AUT.DISABL.)	14

"I" R4IÜ		
Nr.	Denomination	ET
1	M II.+	15↔
2		
3	TRIP II.R.	16↔
4	M II.+	15↔
5		
6	TRIP II.S	17↔
7	M II.+	15↔
8	.	
9	TRIP II.T	18↔
10	K8+ (SELF TEST.+)	19
11		
12	K8 (SELF TEST)	20

"C" O		
Nr.	Denomination	ET
1	BUS „B" OFF	25
2	BUS „B" ON	24
3	BUS „K"OFF	23
4	BUS „K"ON	22
5	BF START	21
6	TRIP I.R	10↔
7	TRIP I.S	11↔
8	TRIP I.T	12↔
9	OPTO-(1-8)	29↔

"A" "B" T4		
Nr.	Denomination	ET
1	POWER SUPPLY +	32
2	POWER SUPPLY -	33
3	TIME SYNCH.+	
4	TIME SYNCH.-	

*Fig. 10 Complete list of connections of a **DTI-OGYD2-EP** device*

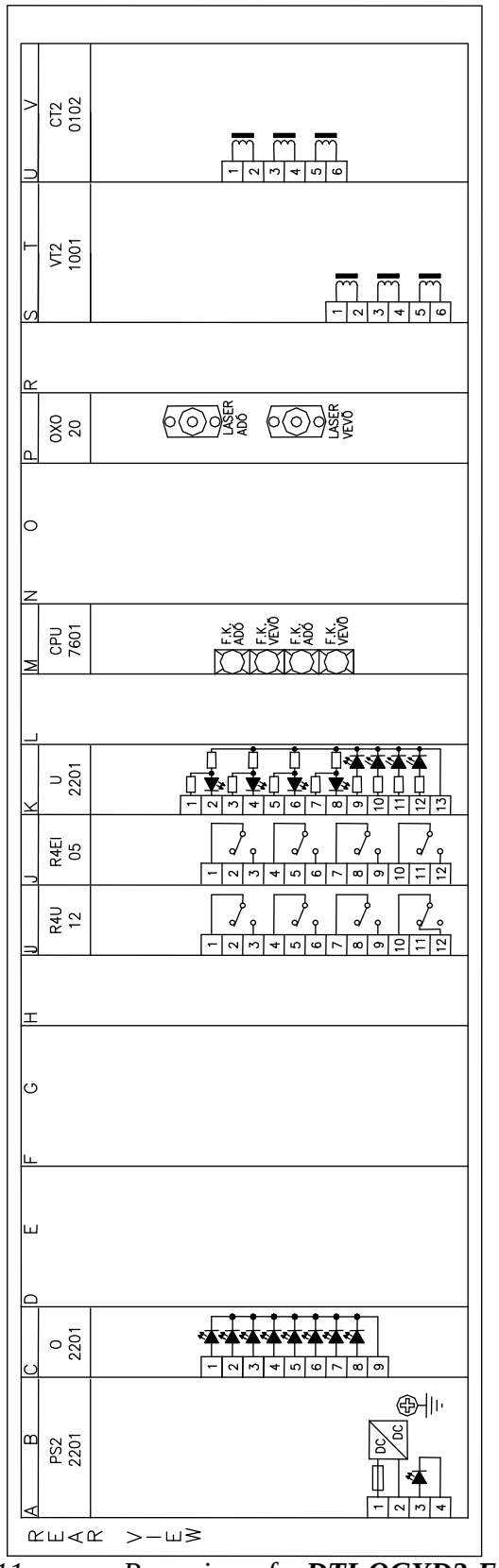


*Fig.11 Rear view of a **DTI-OGYD2-EP** device*

If the protected bus-bar can be divided into sections by bus disconnectors, then the status signals of these disconnectors are input to the central unit. In case of bay structure a dedicated device can be assigned to the disconnector bay, and this device can be connected via high-speed fiber optic cable to the central unit. This bay unit can include all necessary modules (power supply unit, central CPU unit, OXO fiber optic cable driver unit.)

As an example the dedicated disconnector unit may connect the signal circuits according to Fig. 12. The realization depends on the substation configuration, and PROTECTA Co. Ltd. delivers the actual connection diagrams with the OGYD2-EP devices.

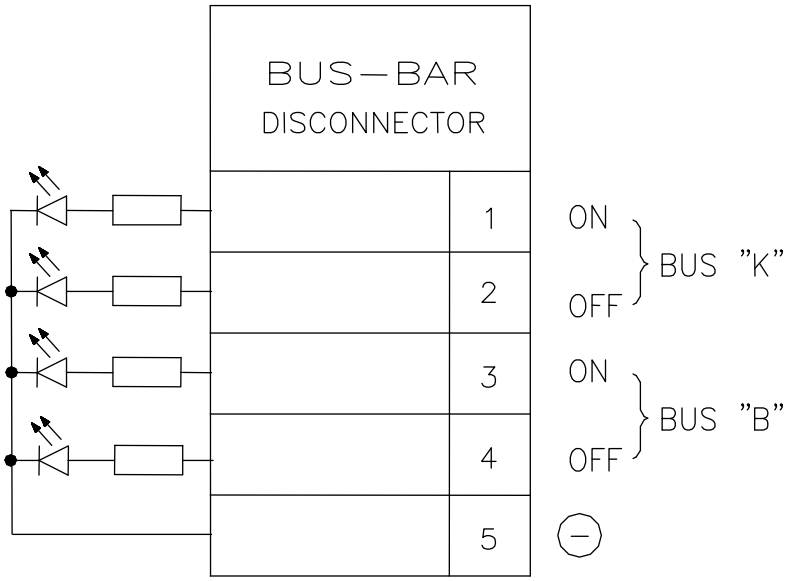


Fig. 12 Connection of a bus-bar disconnector configuration

5.3 Drawings for an OGYD2-EP central unit

The central unit of the OGYD2-EP bus-bar protection system is a fully numerical device with main processor, additional signal processors and fiber optic input units for three fiber optic cable pair connections each.

The main connections of a central unit are drawn in Fig. 13.

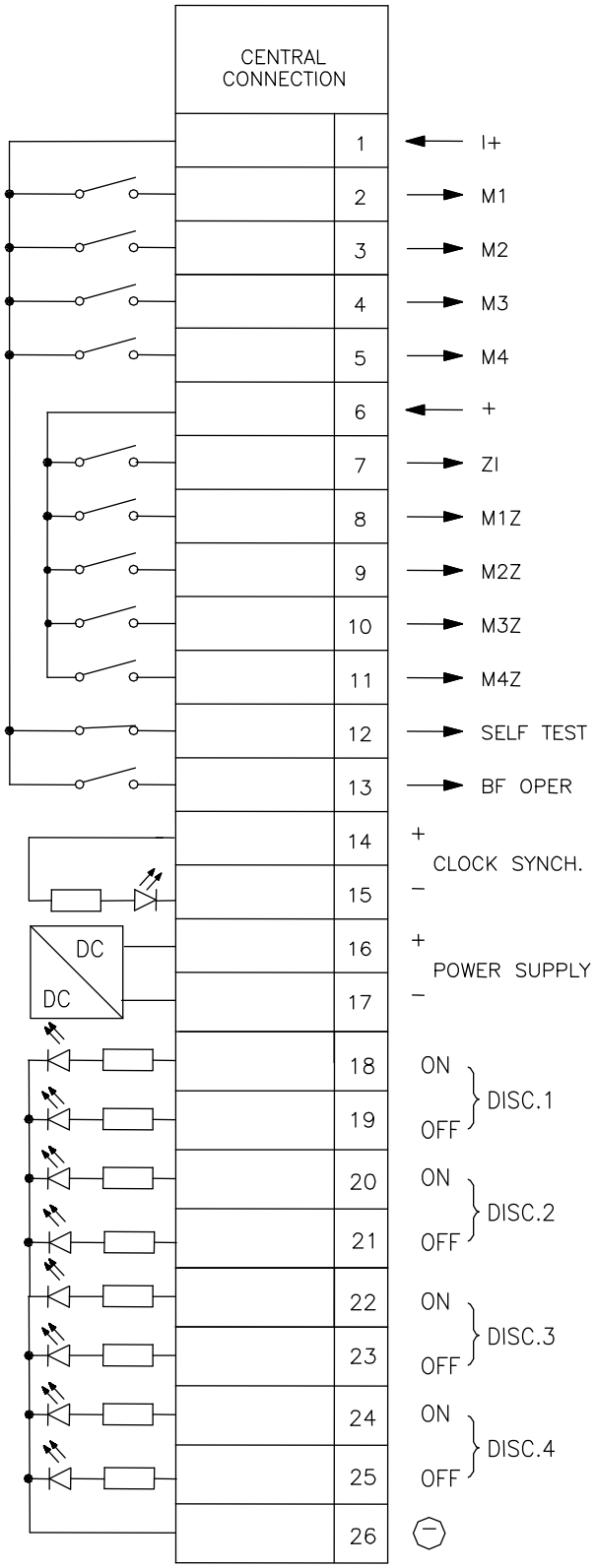


Fig. 13 Connections of the OGYD2-EP central unit

Fig. 14 is the complete list of connections of an ***OGYD2-EP*** central device.

Fig. 15 is the rear view of an ***OGYD2-EP*** central device, indicating the module identifiers, positions and connectors.

"H" R4E		
Nr.	Denomination	ET
1	K1+(I1+)	1↔
2	K1(SELF TEST)	12
3		
4	K2+(I1+)	1↔
5		
6	K2(BF OPER)	13
7	K3+	
8		
9	K3	
10	K4+	
11		
12	K4	

"G" R4		
Nr.	Denomination	ET
1	K5+ (I1+)	1↔
2		
3	K5 (M1)	2
4	K6+ (I1+)	1↔
5		
6	K6 (M2)	3
7	K7+	
8		
9	K7	
10	K8+	
11		
12	K8	

"F" R4E		
Nr.	Denomination	ET
1	K91+	
2		
3	K9	
4	K10+	
5		
6	K10	
7	K11+	
8		
9	K11	
10	K12+	
11		
12	K12	

"E" R4		
Nr.	Denomination	ET
1	K13+(+)	6↔
2		
3	K13 (ZI)	7
4	K14+(+)	6↔
5		
6	K14 (M1Z)	8
7	K15+(+)	6↔
8		
9	K15 (M2Z)	9
10	K16+	
11		
12	K16	

"C" O (BUS-BAR DISC)		
sz.	Megnevezés	Ks
1	Input 1	18
2	Input 2	19
3	Input 3	20
4	Input 4	21
5	Input 5	22
6	Input 6	23
7	Input 7	24
8	Input 8	25
9	Opto-(1-8)	26

"A" "B" T4		
sz.	Megnevezés	Ks
1	POWER SUPPLY+	16
2	POWER SUPPLYP-	17
3	CLOCK SYNCH.+	14
4	CLOCK SYNCH.-	15

Fig. 14 *Complete list of connections of an **OGYD2-EP** central device*

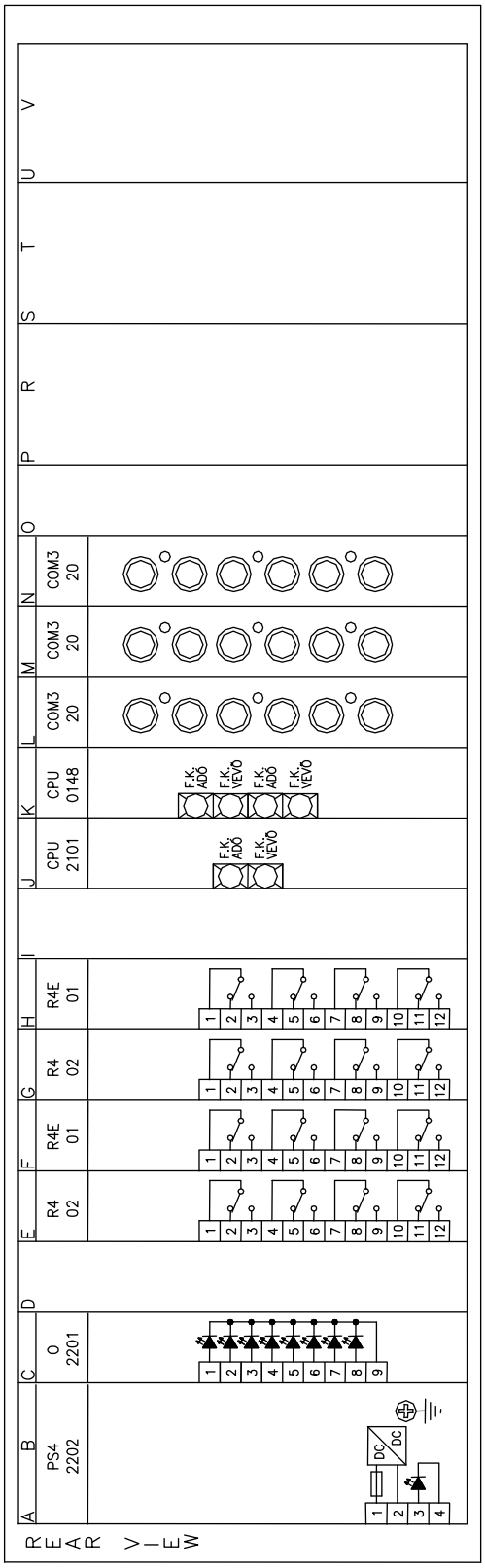


*Fig. 15 rear view of an **OGYD2-EP** central device (example)*

5.4 Modules of the central unit

The remaining part of this chapter describes the modules of the central unit, as an example for the possible configurations. The first underlined italic letter is the location in the rack. The second underlined bold "name" is the identifier of the module as the rear lever of the module shows. The brackets contain the identifier of the printed circuit board, then the bold underlined number is the factory identifier.

A.) **T** ***[EU-TAP(2A) P368]*** **3843**
This is the power supply unit of the ***OGYD2-EP*** device with DC/DC converter. The same power supply unit can be connected to 110 V or 220 V substation battery voltage, since the unit has extreme high voltage tolerance: it extends from 88 V to 310 V. Additionally, the input is polarity protected. There is a digital optical coupler input in the board for clock synchronization.

B.) ***[EU-TAST P369/4]*** **4732 or 5629** This module can not be seen in the ready-mounted state of the device (this is why it does not have handle identifier). This module is located behind the front plate of the device, it can be accessed after removing the front plate. The board serves man-machine interface of the front plate: the keyboard, the connector for serial communication, the LED-s, etc. Both the front plate from the front side, and the printed circuit boards of the other modules from rear side are plugged to this plate.

C.) **O** ***[EU-OPTO P354]*** **4733** Eight optically isolated binary inputs.

D.) **O** ***[EU-OPTO P354]*** **4733** Eight optically isolated binary inputs.

E.) **O** ***[EU-OPTO P354]*** **4733** Eight optically isolated binary inputs.

F.) **R4** ***[EU-RELAY P424]*** **4731** Four output relays (K13, K14, K15, K16).

G.) **R4** ***[EU-RELAY P424]*** **4758** Four output relays (K9, K10, K11, K12).

H.) **R4E** ***[EU-RELAY P424]*** **4731** Four output relays (K5, K6, K7, K8).

I.) **R4** ***[EU-RELAY P424]*** **4758** Four output relays (K1, K2, K3, K4).

J.) **CPU MAIN** ***[EU-198A P436]*** **7069** Central unit with the main processor, memories, I/O divers, serial input/output, communication optical fiber cable connector with its driver, integrated program monitoring with Watch Dog, event memory for 50 events, event sequence recorder for 300 events with 1 ms resolution.

K.) **CPU DSP** ***[EU-196A P352]*** **5613** Digital signal processor for the differential protection central function (CPU OGYD).

L.) **COM3** ***[EU-MULTICOM3 P479]*** COM3 board for three feeders or independent disconnecor switches (e.g. sectionalisers), in order to receive the optical fiber cable pairs.

M.) **COM3** ***[EU-MULTICOM3 P479]*** COM3 board for three feeders or independent disconnector switches (e.g. sectionalisers), in order to receive the optical fiber cable pairs.

N.) **COM3** ***[EU-MULTICOM3 P479]*** COM3 board for three feeders or independent disconnector switches (e.g. sectionalisers), in order to receive the optical fiber cable pairs.

O.) **COM3** ***[EU-MULTICOM3 P479]*** COM3 board for three feeders or independent disconnecor switches (e.g. sectionalisers), in order to receive the optical fiber cable pairs.

P.) and *R.)* Cover plate (8TE empty place) or other two additional COM3 boards if more feeders are connected to the bus-bar.

S.) és *T.)* Cover plate (8TE empty place) or other two additional COM3 boards if more feeders are connected to the bus-bar.

U.) és *V.)* Cover plate (8TE empty place) or other two additional COM3 boards if more feeders are connected to the bus-bar.

The structure of the ***OGYD2-EP*** numerical bus-bar and breaker failure protection and the number of the applied COM3 communication units depends on the primary configuration of the substation.

5.5 The front plate of the central unit and the large graphic display

Fig. 16 shows the front plate of the central unit.

The right side of the front plate contains the man-machine interface of all EuroProt devices. (The detailed description is in the *EuroProt complex protection hardware and software description and user's manual).* The LED assignment is described in chapter 3.7.

The left side of the front plate is the location of the large graphic display. To the right of this display the six push-buttons with left arrow serve the communication with the display.

When the device is energized the graphic display shows the bus-bar configuration with the bays of the substation. This scheme shows the status of the disconnectors, and the status signal errors are indicated as well.

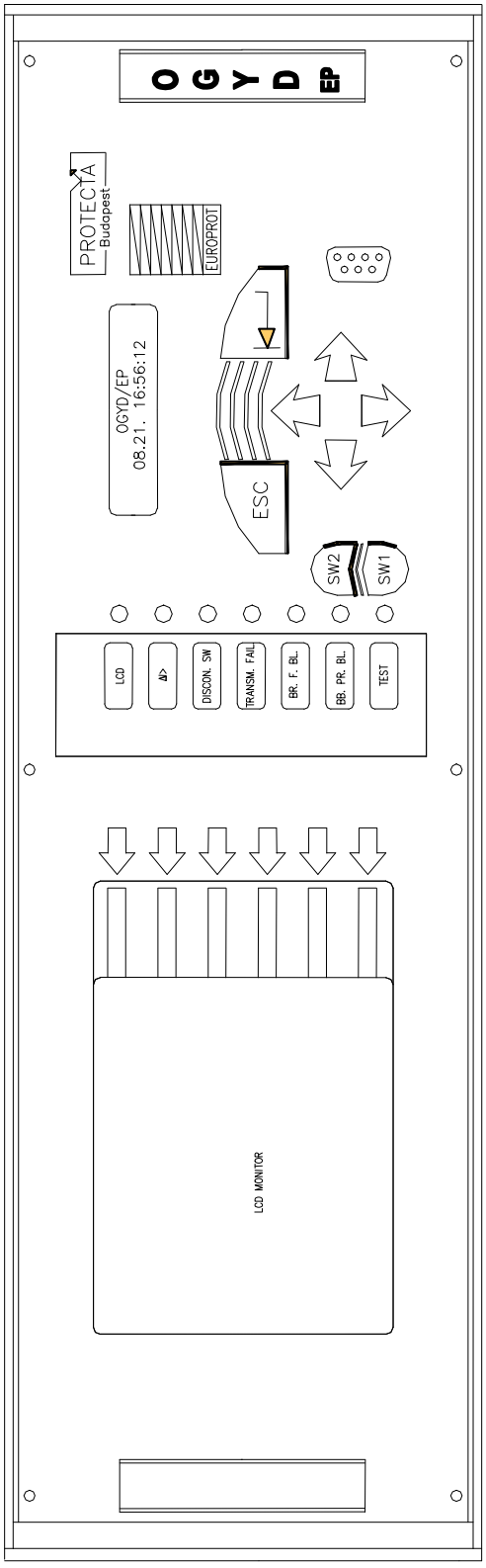
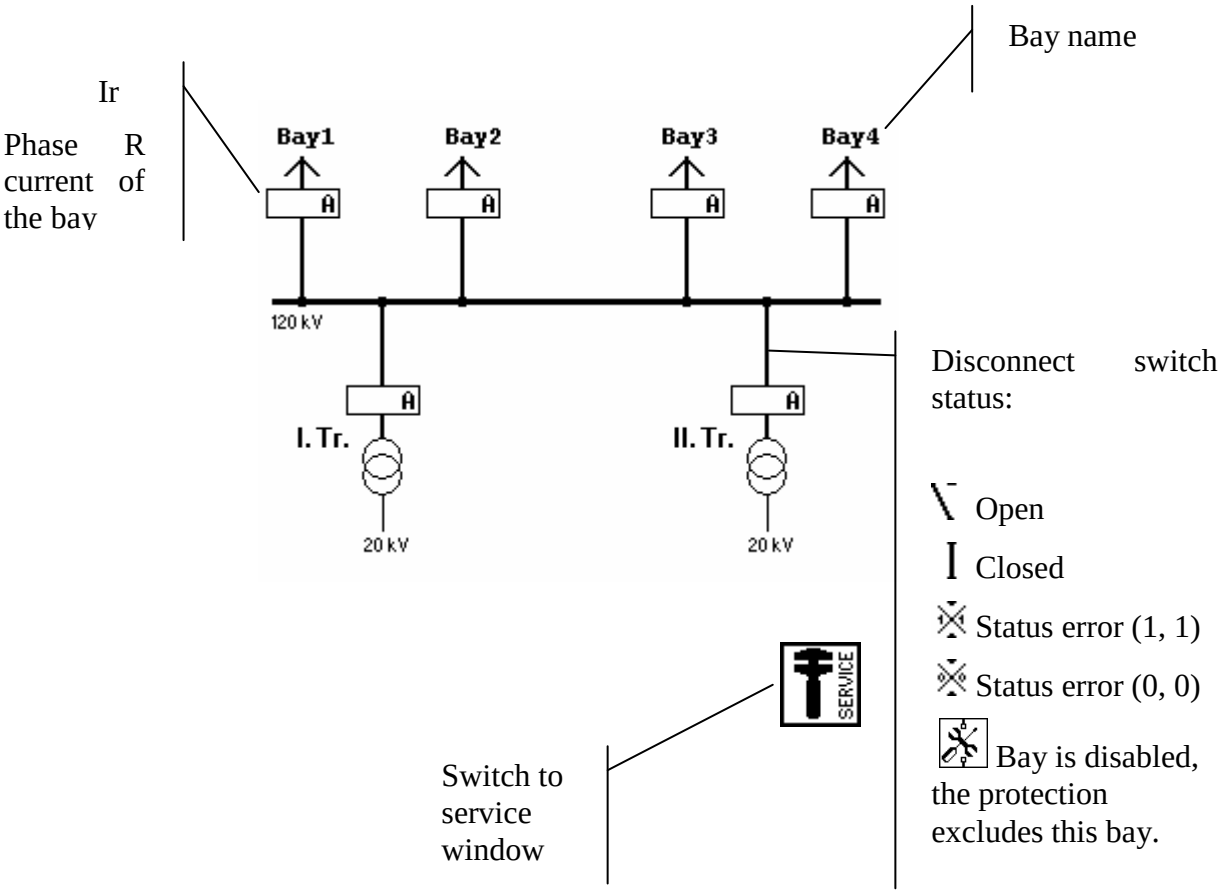


Fig. 16 Front view of the central unit

5.5.1 Displaying the bus-bar configuration:

If normal operation the graphical LCD displays the single line scheme of the bus-bar, and shows the status information of the disconnect switches and the measured current values.



5.5.2 Service window:

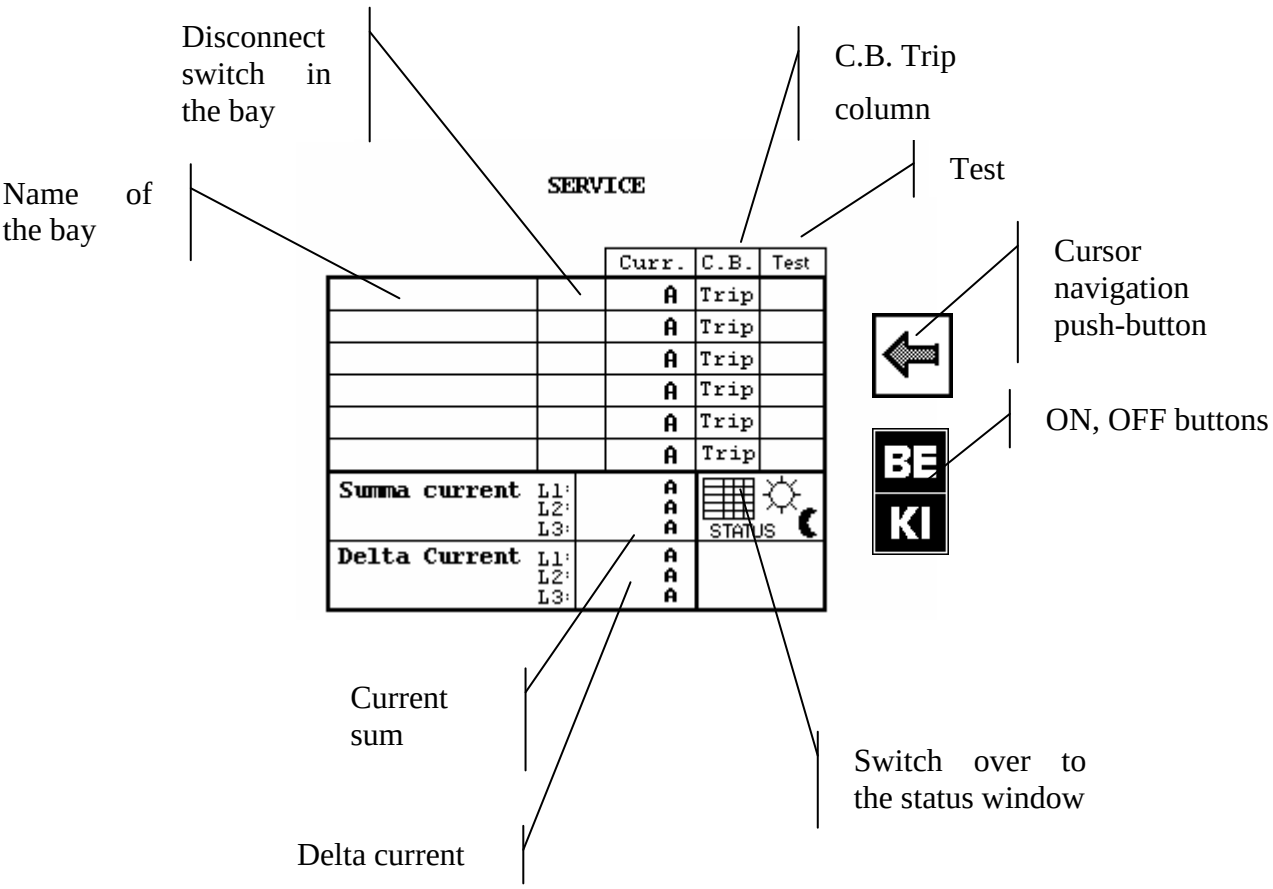
The service window helps checking the balanced state of the differential protection. This window displays the status of all disconnect switches in all bays, shows the measured current values and the calculated delta and sum current values in all three phases.

If the protection is switched over to TEST state, there is possibility to check the consistency of the current directions in the bays, and the checking of the trip commands is possible as well.

The TEST state supports commissioning. In this case the bus-bar is considered to be a single protected unit, independently of the state of the disconnect switches. The bays can be included into the protected system one-by-one by pressing the ON push-button in the Test

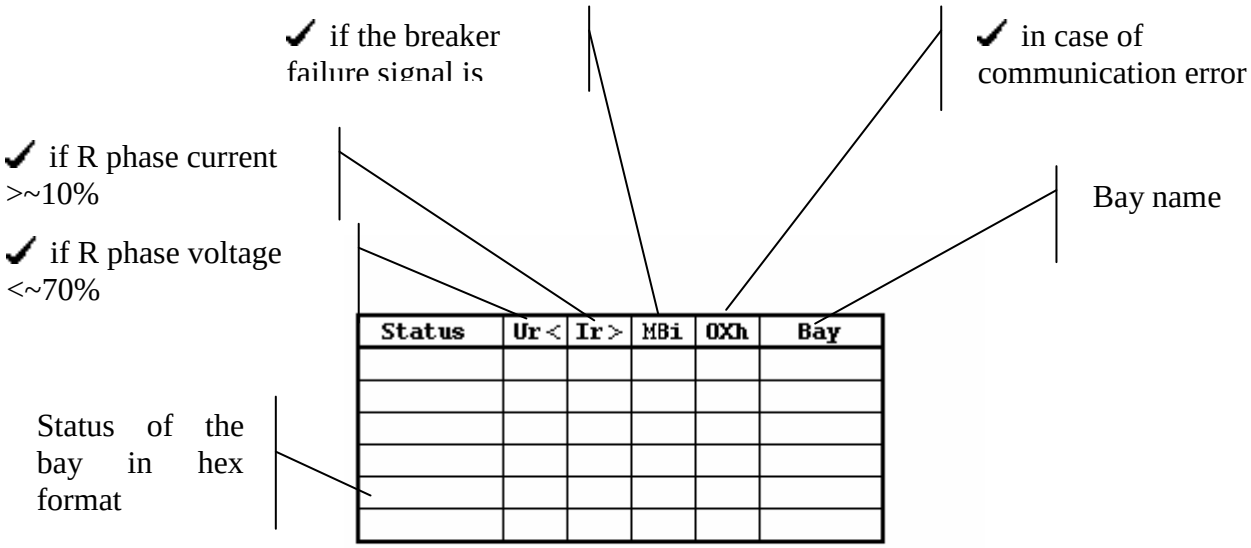
column selected with the navigation arrows. In the row of the activated bays a checkmark signals the active status, meaning the participation in the delta and sum currents. This function supports checking the correct direction of the currents in the bays, and independently of the current values, no trip command is generated in the test state.

To check the operation of the trip command the OFF push-button has to be activated after finding the appropriate bay "C.B. Trip" field with the navigation arrows.



5.5.3 The status window:

The status window displays the actual state of the individual bays. The energised state, the load current, the breaker failure status and the healthy connection to the central unit via fibre optic cable are displayed here.



In the bus-bar configuration window when pressing the arrow push-button to the right of the service icon the list of the bays is displayed with disconnecor states and additional information.

Pressing the "TEST" arrow the information is displayed to support commissioning. The bus-bar is displayed in this case independently of the disconnector states, containing only one assigned measuring element. The bays can be connected one-by-one, independently of the disconnector states. The "connected" bays are marked with a check-mark (√), indicating that the current of the bay is involved in the calculation of the biasing current. This function supports checking the correct polarity connection of the current transformers, and independently of the current magnitude no trip command is generated. For easy checking the "a" value (IOffset) is not subtracted from the measured currents. This method is useful in commissioning and checking. In this "TEST" state trip command can be generated, which are then performed by the bay units.

The individual bays can be disabled one-by-one with parameter setting. (On the PC's Parameter screen it means writing a "+" character for the *Bay fix disconnected* parameter.) The disabled state is indicated on the display of the device with a wrench symbol. In this state the central unit considers the bay – independently of the state of the disconnector - to be disconnected, the current is reset to zero and the voltage is supposed to be healthy. All functions operate with these substituted information.

The fix disconnection of the bay is useful if the bay is disconnected for maintenance.

The role of the arrow pushbuttons to the right of the display is indicated by software icons on the screen. The actual configuration of the display is described individually attached to the bus-bar protection device.

6 Technical data

(valid both for the central unit and for the bay units)

6.1 Specification

Rated secondary current, I_n	1 A or 5 A
Rated secondary line voltage, U_n	100 V or 200 V
Rated frequency	50 Hz
Overload capacity, in voltage circuits, continuous	$1 \cdot 2xU_n$
Overload capacity, in current circuits, continuous	$4xI_n$
1 s	$100xI_n$
Dynamic current limit	$100xI_n$
Minimum "*time-to-saturation*" demand	$t_T \geq 1$ ms
Accuracy of digital timer	± 3 ms at 10 ms steps ± 12 ms at 1s steps
Optical coupler inputs (central unit)	8 …16 pcs
Output relays (central unit)	16 pcs print relays
Output contacts ratings (central unit)	
rated switching voltage	250 V
continuous load current	8 A
switching on current	16 A
In signal circuits	
breaking current at 220 V DC,	
pure conductive circuit	0·25 A
L/R = 40 ms load	0·2 A
In trip circuits:	
L/R = 40 ms load	4 A
Busbar protection operating time	
2 x $Id_{\text{basic sensitivity}}$	30 ms
5 x $Id_{\text{basic sensitivity}}$	25 ms
50 x $Id_{\text{basic sensitivity}}$	20 ms
Consumption, basic device	80 mA, 220 V=
for each 3 feeder (each COM3 board)	36 mA, 220 V=
for each digital input	4 mA, 220 V=
Auxiliary dc battery voltage (the same supply unit)	220 V, 110 V
voltage tolerance	88 to 310 V
Permissive ambient temperature	0^0 to 50^0C
Insulation test (IEC 255)	2 kV, 50 Hz
	5 kV, 1·2/50 μs
Disturbance test (IEC 255)	2·5 kV, 1 MHz
Electrostatic discharge test (ESD) (IEC 801-2)	8 kV
Burst test (IEC 801-4)	2 kV
Electromagnetic (radiofrequency) interference test	IEC 801-3

6.2 Setting ranges

Parameters of the measuring element (primary values):

Basic sensitivity, [I base setting]	50...5000 A, steps 10 A
Biasing (slope), [K]	50...80 %, steps 5 %
Maximum value of feeder load, [I Offset, "a"]	0...5000 A, steps 10 A
CT circuit monitoring failure current, [Iset (CT error)]	10...5000 A, steps 25 A

Parameters of the bays (stored in the central unit):

1st feeder, CT primary rated current, [CTPr A]	50...5000 A, steps 25 A
2nd feeder, CT primary rated current, [CTPr A]	50...5000 A, steps 25 A
…	
nth feeder, CT primary rated current, [CTPr A]	50...5000 A, steps 25 A

Timer parameters:

CT circuit monitoring timer, operating and drop out delay, [CT error delay]	100...32000 ms, steps: 10 ms
CB failure protection, 1st timer (BF timer 1)	0...32000 ms, steps 10 ms
CB failure protection, 2nd timer (BF timer 2)	0...32000 ms, steps 10 ms
Disconnect switch disagreement protection timer (Disc.status error timer)	1...60 s, steps 1 s

Voltage relay parameters:

Feeder voltage checks (Bay voltage condition)	0,7.Un, *fixed value*

Communication parameters:

External communication mode, [Opto / RS (0/1)]	optical fiber cable / RS 232
Optical fiber cable operation method, [1=yes]	1: loop, 0: radial
Series communication speed (BaudRate)	150 to 19200 Baud (with 2x steps)
Substation code	0 to 254
Device code	0 to 254

6.3 Size

An *EuroProt* device is always of rack-mounted type. One of the design forms is suitable to be mounted directly into a standard 19" inch cabinet frame. The other designs are panel mounted devices with raised-hinged or flush mounted forms.

The central unit of the OGYD2-EP bus-bar protection and breaker failure protection:

Outline size of a 19 inch cabinet frame mounted device and that of a panel mounted device with flush mounted form is as follows.

Width: 483 mm, height: 132.5 mm, depth: 201 mm.

Outline size of a panel mounted device with raised-hinged form is as follows.

Width: 490 mm, height (with terminals): 250 mm, depth: 250 mm.

The feeder unit of the OGYD2-EP bus-bar protection and breaker failure protection:

It is a printed circuit board plugged into the *EuroProt* protection. The size of the device can be the same as that of the central unit, but it can be smaller as follows.

Outline size of a 19 inch cabinet frame mounted device and a panel mounted device with flush mounted form is as follows.

Width: 483 mm, height: 132·5 mm, depth: 201 mm.

The width of the panel mounted device in flush mounted form can be smaller than the size above.

A panel mounted device with raised-hinged form has three different versions as follows.

Size with terminals:

Maximum outline size:
Width: 490 mm, height: 250 mm, depth: 250 mm.

Medium outline size:
Width: 384 mm, height: 250 mm, depth: 250 mm.

Minimum outline size:
Width: 277 mm, height: 250 mm, depth: 250 mm.

Without terminals and fittings for raised-hinged form:

Maximum outline size:
Width: 490 mm, height: 132.5 mm, depth: 201 mm.

Medium outline size:
Width: 384 mm, height: 132.5 mm, depth: 201 mm.

Minimum outline size:
Width: 277 mm, height: 132.5 mm, depth: 201 mm.

Terminal type at panel mounted design is as follows (terminals are placed only below the device).
Switchable: WTL6/1 Weidmüller,
Not switchable: WDU 2,5 Weidmüller.

Weight of the central unit of the protection is ≈ 8 kg.

7 Ordering information

On ordering the ***OGYD2-EP*** bus-bar protection and breaker failure protection, the following data have to be given:

- the DC supply voltage value,
- the primary disposition of the protected bus-bar (with CB's, disconnecor switches, location of the measuring transformers),
- maximum fault current,
- minimum CT primary rated current, and the related accuracy limit factor of CT-s,
- the requested design of the bus-bar protection (centralized, decentralized),
- mounting version form of the protection.

On ordering, it is advised to consult with the experts of PROTECTA Electronics Co. Ltd.